UNIVERSITY OF CALIFORNIA.

AGRICULTURAL EXPERIMENT STATION.

BERKELEY, CAL.

E. W. HILGARD, Director. BULLETIN No. 113.

California Walnuts, Almonds, and Chestnuts;

THEIR COMPOSITION AND DRAFT UPON THE SOIL.

The Bleaching of Nuts by Dipping.

NOVEMBER, 1896.

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CALIFORNIA WALNUTS, ALMONDS, AND CHESTNUTS;

THEIR COMPOSITION AND DRAFT UPON THE SOIL.

By George E. Colby.

In order to answer the many inquiries relating to the composition of California nuts and to the fertilizers required to replace the draft upon the soil, this Station, last year, began the work of investigating samples of nuts from various parts of the State. The work is a continuation of that begun years ago upon the fruits of California; special bulletins and the yearly reports contain the records of that study.

The following varieties of walnuts, almonds, and chestnuts received from growers and from the Foothill Station have been analyzed, each variety of nut and its parts being considered separately. The physical analysis, the ash, nitrogen contents, and the kinds of fertilizers necessary to replace the soil ingredients taken away by the nut crops, forms the *first part* of the present bulletin; the *second part* deals briefly with the composition of the kernels of the nuts with reference to their food values.

WALNUTS.

The following varieties of walnuts were examined:

No. 18. *California Softshell*, from Geo. W. Ford, Santa Ana, Orange County; sample received September 12, 1895.

No. 13. *California Softshell*, from A. D. S. McCoy, Pasadena, Los Angeles County; sample received September 25, 1895.

No. 14. *California Softshell* (Santa Barbara Softshell), from the Foothill Experiment Station, Amador County; sample received September 30, 1895.

No. 16. *Bijou*, from the Foothill Experiment Station, Amador County; sample received October 8, 1895.

No. 17. *California Native Black*, from the Foothill Experiment Station, Amador County; sample received October 8, 1895.

No. 15. *American Black Walnut*, from the Foothill Experiment Station, Amador County; sample received September 30, 1895.

The above-named walnuts were gathered from trees upward of eight years old, grown in districts which well represent walnut-producing localities; especially is this the case with those from Southern California. The Bijou walnut is more of a curiosity than anything else, still it deserves the place given it.

The following table gives the results of the physical analysis, and the ash and nitrogen content of the parts of the walnuts:

ANALYSES OF CALIFORNIA WALNUTS.

	California Softshell.			Bijou.	California Native Black.
	Santa Ana. No. 18.	Pasadena. No. 13.	Amador County. No. 14.	Amador County. No. 16.	Amador County. No. 17.
PHYSICAL ANALYSIS.					
Entire Fresh Fruit—					
Average weight of nuts ---grams*	13.30	15.80	13.30	31.00	14.10
Average weight of hulls ----grams*	20.00	17.50	11.70	49.00	35.90
Total weight ----------grams*	33.30	33.30	25.00	80.00	50.00
Nuts, proper----------per cent	40.00	47.50	45.00	37.50	30.00
Hulls----------per cent	60.00	52.50	55.00	62.50	70.00
Fresh Nuts (hulled)—					
Average weight of kernels --grams*	6.00	6.65	5.10	8.34	3.75
Average weight of shells ----grams*	7.30	9.15	8.20	22.66	10.35
Total weight ----------grams*	13.30	15.80	13.30	31.00	14.10
Kernels----------per cent	45.00	42.10	38.30	26.90	25.90
Shells----------per cent	55.00	57.90	61.70	73.10	74.10
ASH AND NITROGEN.					
Fresh Nuts (hulled)—					
Ash ----------per cent	.78	.64	.83	.68	.57
Nitrogen ----------per cent	1.00	1.00	1.08	.84	.98
Fresh Kernels—					
Ash ----------per cent	1.16	1.05	1.18	1.36	1.36
Nitrogen ----------per cent	1.82	2.09	2.45	2.40	3.16
Fresh Shells—					
Ash ----------per cent	.61	.35	.62	.41	.30
Nitrogen ----------per cent	.32	.21	.23	.20	.20
Fresh Hulls—					
Ash ----------per cent	1.15	1.83	2.21	1.06	.51
Nitrogen ----------per cent	.11	.28	.17	.15	.12

*About 30 grams are equivalent to one ounce.

The Bijou walnut is very large, weighing 2.6 ounces as an average, or more than twice the weight of ordinary walnuts. While the hull is also quite thick, its percentage of the entire fruit, 62.5, is not very much greater than that of the Softshells, and even less than that of the California Native Black. The same is true with regard to the proportion of shell in the hulled nut, 73.1%.

The hulls of the California Black walnut are also very thick, and comprise a greater proportion (seven tenths) of the entire fruit, than in either the Bijou or the Softshells. The nut is also very small, and has a smaller kernel than any of the other varieties examined; its shell comprises three fourths of the weight of the nut.

Between the three Softshell varieties there are no differences other than would naturally occur in samples from different trees or localities. The average weights are, of nuts, 14.1 grams; hulls, 16.4 grams; shells, 8.2 grams, and of kernels, 5.9 grams. The hulls of the sample from Santa Ana were thickest, but the nuts were the same in weight as those from the Amador Foothill Station. The Pasadena sample excelled the others a little in weight of nut and kernel, though the proportion between these two was greater.

ALMONDS.

The following varieties of almonds were examined:

No. 5. *I X L*, from G. K. Swingle, Davisville, Yolo County; sample received September 13, 1895.

No. 8. *I X L*, from A. T. Hatch, Suisun, Solano County; sample received September 16, 1895.

No. 11. *I X L*, from Miss A. C. H. Weber, Skyland, Santa Cruz County; sample received September 21, 1895.

No. 2. *Papershell*, from the Foothill Experiment Station, Amador County; sample received August 31, 1895.

No. 6. *Languedoc*, from N. W. Blanchard, Santa Paula, Ventura County; sample received September 13, 1895.

No. 9. *Ne Plus Ultra*, from A. T. Hatch, Suisun, Solano County; sample received September 16, 1895.

No. 7. *Drake's Seedling*, grown at the Foothill Experiment Station, Amador County; sample received September 14, 1895.

No. 1. *King's Softshell*, grown at the Foothill Experiment Station, Amador County; sample received August 31, 1895.

No. 4. *Nonpareil*, grown at the Foothill Experiment Station, Amador County; sample received August 31, 1895.

No. 10. *Nonpareil*, from A. T. Hatch, Suisun, Solano County; sample received September 16, 1895.

No. 3. *Marie Dupreys*, grown at the Foothill Experiment Station, Amador County; sample received August 31, 1895.

The following table contains the results of the physical analysis and the ash and nitrogen of the several parts of the fruit:

Analyses of California Almonds.

	Light Weight.						Heavy Weight.			
	I X L, Davisville No. 5.	King's Softshell, Amador County. No. 1.	Nonpareil. Average of Nos. 4 and 10.	Ne Plus Ultra, Suisun. No. 9.	Marie Dupreys, Amador County. No. 3.	I X L, Suisun. No. 8.	Drake's Seedling, Amador County. No. 7.	I X L, Skyland. No. 11.	Paper-shell, Amador County. No. 2.	Languedoc, Santa Paula. No. 6.
PHYSICAL ANALYSIS.										
Entire Fresh Fruit—										
Average weight of nuts ..... grams*	2.60	2.30	2.70	3.00	5.00	3.70	5.00	7.00	3.00	4.50
Average weight of hulls ..... grams*	2.60	6.80	6.40	7.00	6.10	8.80	11.60	13.00	17.00	20.50
Total weight ..... grams*	5.20	9.10	9.10	10.00	11.10	12.50	16.60	20.00	20.00	25.00
Nuts, proper ..... per cent.	50.00	25.30	30.00	30.00	45.00	30.00	30.00	35.00	15.00	18.00
Hulls ..... per cent.	50.00	74.70	70.00	70.00	55.00	70.00	70.00	65.00	85.00	82.00
Fresh Nuts (hulled)—										
Average weight of kernels ..... grams*	1.30	1.36	1.46	1.88	2.22	2.09	1.65	2.60	2.10	2.49
Average weight of shells ..... grams*	1.30	.94	1.24	1.12	2.78	1.61	3.35	4.40	.90	2.01
Total weight ..... grams*	2.60	2.30	2.70	3.00	5.00	3.70	5.00	7.00	3.00	4.50
Kernels ..... per cent	50.00	60.00	63.30	62.60	44.50	56.70	33.00	37.20	70.00	55.50
Shells ..... per cent	50.00	40.00	36.70	37.40	55.50	43.30	67.00	62.80	30.00	44.50
ASH AND NITROGEN.										
Fresh Nuts (hulled)—										
Ash ..... per cent	2.08	1.15	1.55	2.21	1.05	2.13	1.02	1.27	1.26	1.27
Nitrogen ..... per cent	1.70	1.49	2.13	2.34	1.11	2.27	.96	.78	1.72	1.41
Fresh Kernels—										
Ash ..... per cent	2.00	1.48	1.55	2.16	1.27	2.07	1.49	1.20	1.62	1.45
Nitrogen ..... per cent	3.05	2 28	2.98	3.42	2.13	3.62	2.41	1.87	2.42	2.43
Fresh Shells—										
Ash ..... per cent	2.24	.73	1.83	2.30	.85	2.21	.80	1.31	.44	1.30
Nitrogen ..... per cent	.37	.31	.37	.51	.30	.52	.23	.16	.10	.14
Fresh Hulls—										
Ash ..... per cent	3.72	1.11	2.06	2.66	1.39	2.41	1.32	1.06	1.17	1.17
Nitrogen ..... per cent	.55	.11	.31	.64	.25	.38	.12	.13	.16	.20

* About 30 grams are equivalent to one ounce.

In the above table the arrangement is in the order of lowest to highest total fruit (nuts and hulls), a general division of light and heavy weights. The I X L from Davisville thus stands as the lightest of all the varieties, though its nut is somewhat heavier than that of King's Softshell. On the other hand, the Languedoc almond is the heaviest of all, though its nut is about like that of the light-weight varieties. The I X L almond from Skyland, on the Santa Cruz Mountain, has also a large hull, but with it the largest nut of the lot—nearly three times the weight of several of the others. The Papershell of the Foothill Station has a very heavy hull, and a nut as small as that of the light-weight Ne Plus Ultra, the proportion between the hulls and nut being greater than with any other of the varieties.

We thus see that although an almond fruit may be large and weighty as it comes from the tree, it by no means follows that the nut is also large; and, unless the cleaned product from a tree bearing such large fruit is proportionately greater it may not be more profitable than that from small-sized fruits.

In examining the results as to the proportion between the kernel and the shell, we find that the heaviest kernels are with the heavy-weight varieties, with the exception of Drake's Seedling, which falls below some of the light-weight almonds, and the Marie Dupreys, which ranks next to the Languedoc, the heaviest kernel of all. It is interesting to note that in the small I X L from Davisville there are equal weights of kernel and shell.

CHESTNUTS.

The following chestnut samples were received:

No. 12. *Italian*, from N. W. Blanchard, Santa Paula; sample received September 23, 1895.

No. 19. *Italian*, from J. Cuneo, Clinton, Amador County; sample received October 30, 1895.

The following table give the results of physical analysis, and show also the ash and nitrogen contents:

ANALYSES OF CALIFORNIA CHESTNUTS.

	Italian Variety.	
	Santa Paula, Ventura County. No. 12.	Clinton, Amador County. No. 19.
PHYSICAL ANALYSIS.		
Entire Fresh Fruit—		
Average weight of nuts ..... grams*	28.50	21.67
Average weight of hulls ..... grams*	21.50	11.66
Total weight ..... grams*	50.00	33.33
Nuts ..... per cent	57.00	65.00
Hulls ..... per cent	43.00	35.00
Fresh Nuts (hulled)—		
Average weight of kernels ..... grams*	24.08	18.34
Average weight of shells ..... grams*	4.42	3.33
Total weight ..... grams*	28.50	21.67
Kernels ..... per cent	84.50	84.60
Shells ..... per cent	15.50	15.40

ANALYSES OF CALIFORNIA CHESTNUTS—Continued.

	Italian Variety.	
	Santa Paula, Ventura County. No. 12.	Clinton, Amador County. No. 19.
ASH AND NITROGEN.		
Fresh Nuts (hulled)—		
Ash ..... per cent	.83	.80
Nitrogen ..... per cent	1.02	.59
Fresh Kernels—		
Ash ..... per cent	.75	.83
Nitrogen ..... per cent	1.06	.65
Fresh Shells—		
Ash ..... per cent	.99	.63
Nitrogen ..... per cent	.76	.26
Fresh Hulls—		
Ash ..... per cent	1.22	1.09
Nitrogen ..... per cent	.50	.22

* About 30 grams are equivalent to one ounce.

Of the two samples of chestnuts examined, that from Santa Paula is clearly the better, for it has a heavier nut and kernel, though the proportion of nut, with reference to the entire fruit, is greater in that from Amador County. The averages of the two samples, taken as a possible average for chestnuts in general, are, hulls, 16.58 grams; nuts, 25.08 grams; shells, 3.88 grams; and kernels, 21.21 grams.

NITROGEN CONTENTS OF WALNUTS, ALMONDS, AND CHESTNUTS.

Referring, again, to the tables above where the nitrogen is reported for nuts, kernels, shells, and hulls, we find that the average percentage for hulled nuts stands thus: walnut, 1.02%; almond, 1.64%; chestnut, 0.80% of nitrogen. The largest part of this is contained in the kernel, as that in the shell of the walnut is but one sixth, that in the almond shell one twelfth, and that of the chestnut shell one tenth of the whole nitrogen of the hulled nut.

Comparing this with the only European data we have (that based upon the dried kernels), we find that the European nitrogen-content agrees closely with that mentioned above for the California nuts. The difference in nitrogen in the kernels of the Pennsylvania and California chestnuts is only a trifle.

ASH INGREDIENTS OF WALNUTS, ALMONDS, AND CHESTNUTS (ENTIRE NUT).

The ash analyses of the various parts of the fruit of the California-grown walnut, almond, and chestnut are given below with such European ash analyses as are available. It would, of course, be interesting to have also the analyses of the ash of the leaves, twigs, branches, and roots of the trees (to obtain which would take months of analytical work), but now our chief care is to look to that part of the tree which is taken away from the orchard—the nut proper—the soil ingredients of which must eventually be replaced by the addition of suitable fertilizers. Doubtless all careful orchardists return to the soil the hulls and the leaves, so that, for the present, the composition of the ashes of the nut alone and not of the entire fruit will be the proper gauge of the replacement.

Amount and Composition of the Ash of California Walnuts, Almonds, and Chestnuts.

Nut (hulled) and Parts of Entire Fruit.	Percentage of Pure Ash in Fresh Substance.	Percentage Composition of the Pure Ash.												
		Potash	Soda	Lime	Magnesia	Peroxid of Iron and Alumina	Br. Oxid of Manganese	Phosphoric Acid	Sulphuric Acid	Silica	Chlorin	Total	Less Excess of Oxygen Due to Chlorin	Total
WALNUT.														
Nut (hulled)	.750	19.96	.83	23.83	11.40	2.49	.64	37.17	2.17	.94	.57	100.00	.13	99.87
Kernel	1.130	12.69	.96	5.57	16.60	3.23	.35	57.83	1.31	.75	.70	99.99	.16	99.83
Shell	.520	28.28	.82	44.88	5.29	1.78	.96	13.14	3.23	1.17	.41	99.96	.10	99.86
Hull	1.730	77.80	.27	7.79	1.80	.62	.12	2.46	2.66	1.28	6.57	101.37	1.43	99.94
European Walnut—meal	5.350	33.08	-----	6.76	12.15	.30	-----	43.74	1.23	1.61	.22	-----	-----	-----
ALMOND.														
Nut (hulled)	1.500	36.63	2.29	11.49	12.23	1.99	.35	28.90	4.12	1.32	.21	99.98	.04	99.94
Kernel	1.620	10.96	1.85	14.53	18.31	.78	.28	48.13	4.64	.24	.27	99.99	.04	99.95
Shell	1.440	64.76	2.81	9.12	5.54	3.40	.42	7.76	3.55	2.48	.14	99.98	.03	99.95
Hull	1.830	64.86	.74	4.10	5.28	4.26	.59	5.62	1.32	12.51	.70	99.98	.15	99.83
European Almond—nut	4.900	27.95	.23	8.81	17.66	.55	-----	43.63	.37	-----	-----	-----	-----	-----
CHESTNUT.														
Nut (hulled)	.826	45.07	1.70	8.82	9.24	.43	.18	23.10	10.84	.22	.40	100.00	.08	99.92
Kernel	.790	48.67	1.20	4.63	8.05	.41	.16	23.55	12.81	.18	.34	100.00	.07	99.93
Shell	.810	29.02	3.92	27.52	14.51	.47	.24	21.10	2.08	.42	.67	99.95	.14	99.81
Hull	1.160	32.23	.99	17.83	10.15	3.93	.58	9.61	5.05	18.69	.90	99.96	.20	99.76
European Chestnut—														
Nut	1.980	39.36	21.73	7.84	7.84	1.03	-----	8.25	3.88	2.32	2.93	-----	-----	-----
Kernel	2.380	56.69	7.12	3.87	7 47	.14	-----	18.12	3.85	1.54	.52	-----	-----	-----
Shell	1.680	2.53	14.21	19.74	24.07	.87	-----	9.89	3.39	3.51	4.54	-----	-----	-----

Some striking results are shown in the above table. We find, for instance, that the potash in the ash of the hulled walnut comprises nearly 20% of the whole ingredients, while that of its hull alone is nearly four times as much, viz., 77.8%. It will therefore be seen that if the hulls of the walnut are not returned to the soil, the dominant ingredient of the fertilizer intended for replacement must be *potash*; while if the hulls are left on the ground the dominant ingredient by far should be *nitrogen*.

The ashes of the parts of the almond and chestnut, on the whole, show few such wide differences in potash as that above given, but still they differ much from each other.

It is an interesting fact that the ash of the kernel of the walnut is, in weight, more than twice that of the shell, while in other nuts it is more nearly equal. Also, that in the kernel of the walnut and almond the phosphoric acid is very largely predominant over the potash, while the reverse is true in the ash of the shell. In the walnut kernel the phosphoric acid comprises nearly 58% of its ash. In the ash of the chestnut the potash is by far the predominant ingredient in both kernel and shell, and is largest in the kernel. The same is true of the European chestnut, the soda of the European chestnut is nearly twenty times that found in our samples. The European walnut-meal has a very large amount of ash; its potash is greater than in the California sample of walnuts, but the phosphoric acid is still predominant.

SOIL INGREDIENTS WITHDRAWN BY NUTS.

From the foregoing tables, relating to ash and nitrogen content, we are enabled to calculate the amount of soil-ingredients withdrawn by the walnut, almond, and chestnut. These amounts, expressed in pounds for each ingredient per 1,000 pounds of fresh nut, both hulled and not hulled, and for a full crop of hulled nuts, are given in the following table. We also append some data relating to stone fruits, as these approach nearest in character to the nuts:

SOIL INGREDIENTS EXTRACTED BY WALNUTS, ALMONDS, AND CHESTNUTS.

	Potash.	Lime.	Phosphoric Acid.	Total Ash.	Nitrogen.
NUTS.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Walnut (hulled), 1,000 lbs., fresh	1.50	1.81	2.78	7.50	10.20
Walnut (hulled), crop of 4,000 lbs.	6.00	7.24	11.12	30.00	40.80
Walnut (not hulled), 1,000 lbs., fresh	8.18	1.55	1.47	12.98	5.41
Almond (hulled), 1,000 lbs., fresh	5.49	1.72	4.33	15.00	16.40
Almond (hulled), crop of 2,000 lbs.	10.98	3.44	8.66	30.00	32.80
Almond (not hulled) 1,000 lbs., fresh	9.95	1.04	2.04	17.29	7.01
Chestnut (hulled), 1,000 lbs., fresh	3.72	.71	1.89	8.20	8.00
Chestnut (not hulled), 1,000 lbs., fresh	3.67	1.20	1.58	9.52	6.40
STONE FRUITS.					
Prunes, 1,000 lbs., fresh fruit	2.66	.13	.53	4.03	1.48
Prunes, crop of 30,000 lbs.	79.70	3.90	15.95	120.90	44.40
Apricots, 1,000 lbs., fresh fruit	2.83	.18	.71	5.16	2.29
Apricots, crop of 30,000 lbs.	84.98	5.40	21.38	154.80	68.70
Olives (European), 1,000 lbs., fresh fruit	8.55	2.32	1.18	94.63*	5.85
Olives, crop of 2,200 lbs.	18.81	5.10	2.59	208.18	12.86

*80.7 lbs. of which is silex, and costs nothing.

In the *total quantity* of *mineral matters* withdrawn from the soil the almond leads with 15 pounds, the chestnut comes next with 8.20 pounds, and the walnut last with 7.50 pounds in 1,000 pounds of the hulled nut. These figures become somewhat changed when referred to the entire fruit. The stone fruits fall much below the above in total ash, excepting the olive, the ash of which, however, is largely silica (nearly eight ninths), an ingredient so plentifully distributed in all soils that it is of no pecuniary value.

Potash.—The data for hulled nuts shows that almonds withdraw 5.49 pounds of potash, as against 3.70 pounds for chestnuts and 1.50 pounds for walnuts, for 1,000 pounds of fresh nuts; however, when these figures are referred to the entire fruit, the walnut and almond take about the same quantity, 8 to 10 pounds, or nearly three times as much as the entire chestnut; with the exception of the olive, the stone fruits do not, on the whole, nearly approach the latter figures for equal weights.

Phosphoric Acid.—The almond again leads in this ingredient, withdrawing 4.33 pounds, the hulled nut of the walnut taking 2.78 pounds, and the chestnut only 1.89 pounds per 1,000 pounds of fresh nuts. These results are again all materially changed when referred to the entire fruit. For equal weights, the stone fruits appear to be very much less exhaustive upon the phosphoric acid than the nuts.

Nitrogen.—Again the almond leads with 16.4 pounds, not nearly approached by the walnut, with 10.20 pounds, or the chestnut with 8.00 pounds of nitrogen withdrawn per 1,000 pounds of fresh hulled nuts. These figures, while materially altered by referring them to the entire fruit, are still very high, and indicate great draft upon the soil—several times more than the prune or apricot. The olive takes up a great deal of nitrogen, so that when this fruit is used for *pickling* its nitrogen must be replaced sooner or later by fertilization; when the fruit is used for *oil* alone, its nitrogen can nearly all go back to the soil in the pomace, as the oil, the part of the olive then sold, takes up no nitrogen. On the other hand, nuts proper carry away all of their large amount of this material, which consequently must be replaced if paying crops are to be continuously produced.

A more directly useful comparison of the above data is obtained when we base the calculations upon the *actual crops* yielded by nuts, prunes, apricots, and olives. For this purpose, crops of fresh prunes and apricots are rated at 30,000 pounds, and olives at 2,200 pounds per acre, crops of clean walnuts at 4,000 pounds, and of almonds at 2,000 pounds per acre. So little is known of the yield of chestnuts in this State that it is hardly safe to offer any data relating to them. With these figures we readily calculate that the *nitrogen* taken away by a crop of walnuts and of almonds amounts respectively to 40.8 pounds and 32.8 pounds; on the other hand, that of a prune crop is 44.4 pounds, and of an apricot crop, 68.7 pounds; the olive crop takes but 12.9 pounds of nitrogen.

This heavy nitrogen-draft by the nut crop is further forcibly illustrated when we carry the calculations to the other soil ingredients. Of these we find the nut crop to remove but a small fraction (one tenth to one thirteenth) as much of *potash* as prune and apricot crops, and only as much as the olive crop; nearly one half as much *phosphoric acid* is taken up by nut crops as by those of the prune and apricot, and all these stand about alike in *lime* taken away.

Thus it appears that when nut orchards need fertilizers, the first call

will ordinarily be for those rich in *nitrogen*; the more so as California soils are not usually highly supplied with this valuable ingredient. As *phosphoric acid* is almost always in limited supply in the soils of the State, it seems that phosphatic fertilizers will be demanded by nut orchards, but this need will probably not arise as soon for them as for the prune and apricot orchards. If the hulls of the walnut and almonds are returned to the orchards, the demand for *potash* will be kept back for many crops, as potash is so plentifully distributed throughout the most of California soils.

Chestnuts do not withdraw as much of potash and phosphoric acid as do the other nuts; but they seem to demand that the soil shall contain sulphates, which are found in surprising amounts in the kernel of the nut.

FOOD VALUE OF NUTS.

Composition of the Kernels of Walnuts, Almonds, and Chestnuts.—The whole table of figures setting forth the results of the work upon the composition of the kernel of these nuts in its various conditions, *i. e.*, the fresh, the air-dried, and the water-free kernel, is rather too large to produce in this bulletin. But full and detailed analyses of all the nuts above named will appear in the next Station Report.

The following summary is, however, given, together with analyses of European-grown nuts, the average of eight analyses of Pennsylvania-grown chestnuts, and some analyses of stone fruits. The results are based upon the water-free substance, and for the present purpose serve to show also how much the various ingredients vary; in the marketable condition of these nuts, the walnuts contain about 2.50%, the almonds 5.0%, and the chestnuts 6.0% of water.

PROXIMATE COMPOSITION OF THE WATER-FREE KERNEL.

	Number of Analyses	Ash	Protein	Carbohydrates.		
				Fiber	Nitrogen-Free Extract	Fat
WALNUTS.		%	%	%	%	%
California-grown—California Softshell	4	1.44	16.99	2.62	13.87	65.08
California-grown—Bijou	1	1.71	18.84	1.50	11.88	66.04
*European-grown—English walnut	-----	2.13	17.17	6.47	8.28	65.95
California Native Black	1	1.77	25.56	1.90	14.71	56.06
California-grown—American Black	1	2.06	31.06	1.65	5.93	59.30
ALMONDS.						
California-grown—different varieties	11	2.14	22.02	3.23	14.99	57.62
*European-grown—sweet almond	1	3.13	25.56	6.93	7.64	56.74
CHESTNUTS.						
California-grown—"Italian"	2	1.68	11.55	3.10	78.45	4.22
†Pennsylvania-grown—different varieties	8	2.89	10.99	3.13	71.76	11.63
*European-grown—average	-----	3.54	11.29	3.32	79.03	2.82
STONE FRUITS.						
California prunes	23	2.50	4.00	93.50		
California apricots	11	3.33	6.66	90.01		
*European olives	-----	4.05	2.61	27.61		65.73

* König. † Penn. Agr. Expt. Station Bull. 16, July, 1891.

The chief ingredient of the walnut and almond kernel is the fat (oil), of which in the walnut there is about 65.0%, and in the almond nearly 58.0% for both the European and the California-grown nuts; this is nearly equal to the oil content of the olive—65.73%. On the other hand, the fat (oil) of the chestnut kernel is but a small fraction of the meat, viz., from about 3.0% in the European to about 11.63% in the Pennsylvania chestnut. The next largest constituent of the almond and walnut kernel is the protein, or flesh-forming ingredients—in the almond, upward of 20.0% to 25.0%, and in the ordinary walnut, about 17.0%; in the chestnut there is only about 11.0%, or about one half that of the other nuts. About three fourths of the chestnut kernel is made up of starch, sugar, dextrin, etc.—"nitrogen-free extract" ingredients, which, like the fat, furnish fuel to the body, though less economically.

Of the stone fruits the prune and apricot, like the chestnut, are largely made up of carbohydrates (sugar, etc.), and contain considerably less protein than the chestnut kernel, and from three to six times less of that ingredient than the almond or walnut kernel.

The above figures are interesting among themselves, and become of more value when considering the food values of these nuts.

All authorities agree upon the fact that nuts are a highly concentrated form of food; caution should, therefore, be followed in their use. Walnuts and almonds possess a higher nutritive value than even the grains; and, as compared with fruits, they rank high in food value, being the true seed only and not made up of fleshy coverings, as the apple, pear, etc.; they, therefore, have less water and a higher nutritive value generally, weight for weight.

Where, in a rational dietary system, other forms of food lack protein or albuminoids and fat, the walnut and the almond will supply, in concentrated shape, those needs; the chestnut, with its high content of starch, sugar, dextrin, etc., may, on the other hand, be used as a substitute for the cereals.

Aside from the chestnut, the edible nuts are looked upon as luxuries, and are quite largely used as such; the chestnut, on the other hand, has for a long time been a staple article of food in Southern Europe.

Increased production will doubtless remove the obstacle of high cost of nuts to the consumer, and in time, if demand arises, may bring the chestnut, at least, into the list of staple foods in this country.

THE BLEACHING OF NUTS BY DIPPING.

By E. W. Hilgard.

The commercial requirement, that the shells of nuts offered for sale shall have a light and uniform tint, has caused the process of sulphuring, so generally applied to drying fruits, to be applied to them also. This process, however, is not only often unsatisfactory as regards the result desired, but even the strongest partisans of fruit-sulphuring admit that almonds and walnuts are frequently injured in their flavor by the needful prolonged treatment in the sulphur-box. This is inevitable so long as the latter is charged with a column of trays, of which the lower portion is necessarily oversulphured, if those at the upper end are to receive any effect at all. The result is that the shell of the fruit below is corroded ("rotted"), and the flavor of the kernel is lost. To some extent this can be avoided by using only a few trays; but in any case the process is very unsatisfactory when the fruit is spotted by rain or otherwise.

At the suggestion of several large growers of nuts, experiments have been undertaken in the laboratory of this Station for the purpose of devising more satisfactory methods, and securing uniformity of bleaching action; which, of course, is best accomplished by using a *bleaching dip of definite strength*, into which the nuts can be dipped for a *definite time*.

Of cheap and readily procurable bleaching agents suitable for the purpose, bleaching powder (also called chlorid of lime) and bisulphite of lime (used in bleaching sugarcane juices) are most available. Our experiments thus far appear to show that the corresponding soda compounds act more rapidly and satisfactorily; the soda-chlorin compound is easily obtained from the commercial bleaching powder, by mixing the solution with a proper proportion of sal soda. The bisulphite of lime is always obtainable at New Orleans.

The chlorid of lime or soda, used alone, is apt to continue to act for some time in the shells of almonds, softening them, and turning them a whitish and rather sickly tint, besides retaining a slight mawkish odor. This can be prevented, and a bright, natural color assured by following up with a dip of the bisulphite, or by very light sulphuring. It should, of course, be understood, that badly stained nuts, to which pulp of the outer shell adheres, can and should be cleaned preparatory to bleaching; best in revolving drums, either with water alone or, more effectually, with water containing from 3% to 5% of sal soda.

Very satisfactory results have been obtained by us by operating as follows: The nuts, placed in a cane or splint basket (such as Chinese use for carrying), are dipped for about five minutes into a solution containing, to every 50 gallons of water, 6 pounds of bleaching powder and 12 pounds of sal soda. They are then rinsed with a hose, and, after draining, again dipped into another solution containing 1% of bisulphite of lime; after the nuts have assumed the desired tint, again rinse with water and then dry. Instead of the second dipping, the nuts may be sulphured for ten or fifteen minutes.

The cost of 50 gallons of the chlorin dip will be about 40 cents; the same bulk of the bisulphite dip, probably considerably less; the time occupied in handling one batch (two dips), twelve to fifteen minutes.

Practice on a large scale will doubtless show some advantageous modifications of the above prescription; but the perfect ease with which a definite result can be secured by solutions of definite strength, acting under the eyes of the operator, seems to commend it for general use in preference to the crude method of the sulphur-box. Of course, nuts that are cracked open and therefore accessible to the solutions would be likely to be injured, but not more so than they are by the sulphur fumes. For English walnuts, either of the two bleaching dips may be used alone.